EVM User's Guide: LM50HVEVM

LM50HV Evaluation Module

Description

The LM50HV evaluation module (EVM) features a single-pole-double-throw (SPDT) switch that allows users to connect a power supply through test points. The LM50HVEVM uses a MSP430F5528 microcontroller along with a USB interface to enable users to datalog results and interface with the LM50HV analog output. The EVM is separated into two sections: the microcontroller section and the sensor section. The sensor section can be separated from the microcontroller section. The sensor side of the EVM must be reconnected to the microcontroller side to operate the LM50HV in a high temperature environment. The EVM has a single-pole-double-throw switch to allow users to evaluate the LM50HV in systems that use a VDD higher than the default 3.3V.

Get Started

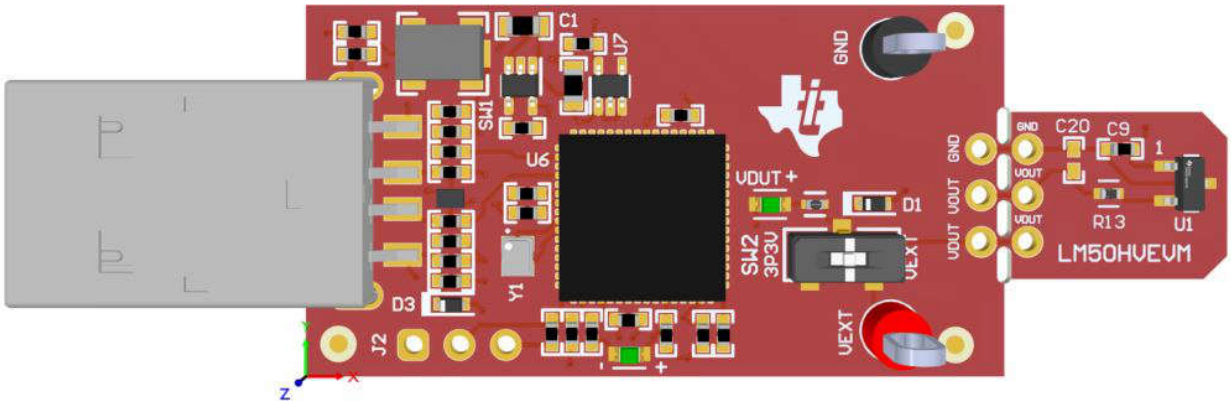
1. Order the LM50HVEVM
2. Connect EVM to computer
3. Go to the LM50HV Gallery page on dev.ti.com to either download the GUI or run on the web
4. Use SPDT to connect external power supply (optional)
5. Refer to the LM50HV data sheet for IC details
6. Visit the E2E forums for support or questions

Features

- Easy-to-use cloud-based GUI is available on the web or can downloaded for offline use
- LM50HV analog temperature sensor IC
- Breakable LM50HV sensor board
- SPDT switch to connect external power supply
- Data logging using MCU integrated ADC

Applications

- EV charging infrastructure
  - AC charging (pile) station
  - DC fast charging station
  - DC fast charging power module
- Solar energy
  - String inverter
- Hybrid, electric and powertrain systems
  - HEV/EV onboard charger (OBC)
  - HEV/EV DC/DC converter
  - HEV/EV inverter & motor control
- Energy storage systems
  - Power conversion system (PCS)
- Rack and server power



LM50HVEVM

1 Evaluation Module Overview

1.1 Introduction

The LM50HV is an analog temperature sensor IC with an extended voltage supply range up to 36V. The analog output is proportional to Centigrade temperature with a 10mV/°C positive slope gain. This user's guide details through the steps to operate the LM50HVEVM evaluation module, designed to evaluate LM50HV temperature sensor. This user's guide describes the characteristics, operation, and use of the LM50HVEVM Evaluation Module (EVM). A complete schematic diagram, printed-circuit board layouts, and bill of materials are included in this document.

1.2 Kit Contents

Table 1-1 details the contents of the EVM kit. Contact the nearest Texas Instruments Product Information Center for missing components. TI highly recommends checking the TI website at https://www.ti.com for the latest revision.

Table 1-1. EVM Kit Contents

Item	Quantity
LM50HVEVM	1

1.3 Specification

The controller side and the sensor breakout side of the EVM have different temperature limits, as shown in Table 1-2. The MSP430 limits the controller side temperature limits. The sensor breakout side temperature is limited by the LM50HV.

Table 1-2. LM50HVEVM Temperature Limits

BOARD SECTION	CONDITIONS	TEMPERATURE RANGE
Controller board	Recommended operating free-air temperature, T_A	-40°C to 85°C
	Absolute maximum junction temperature, $T_{J\ (MAX)}$	95°C
LM50HV breakout board	Recommended operating free-air temperature, T_A	-40°C to 150°C
	Absolute maximum junction temperature, $T_{J\ (MAX)}$	-65°C to 175°C

1.4 Device Information

LM50HV is a linear analog output, temperature sensor. The analog output is proportional to the ambient temperature, with a slope of +10mV/°C over the full sensor temperature range. A quick snapshot of key device specifications is shown in Table 1-3.

Table 1-3. LM50HV Specifications

DEVICE SPECIFICATION	VALUE
Operating temperature range	-40°C to 150°C
Temperature accuracy (0°C to 70°C)	±1.0°C
Temperature accuracy (-40°C to 150°C)	±2.0°C
Maximum output current	1mA
Maximum capacitive load	1000nF
Supply voltage range	3V to 34V

2 Hardware

2.1 Overview

Figure 2-1 and Figure 2-2 show the top view and bottom view of the LM50HVEVM.

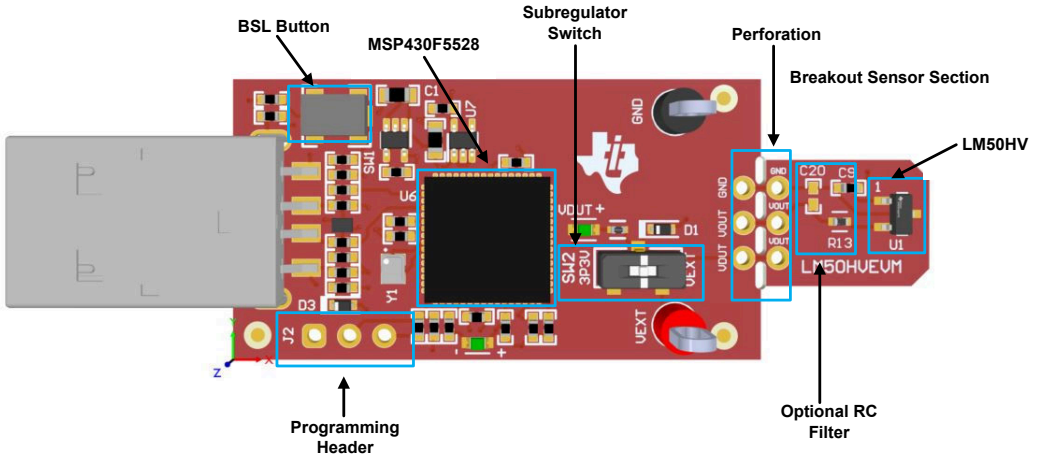


Figure 2-1. LM50HVEVM Board (Top View)

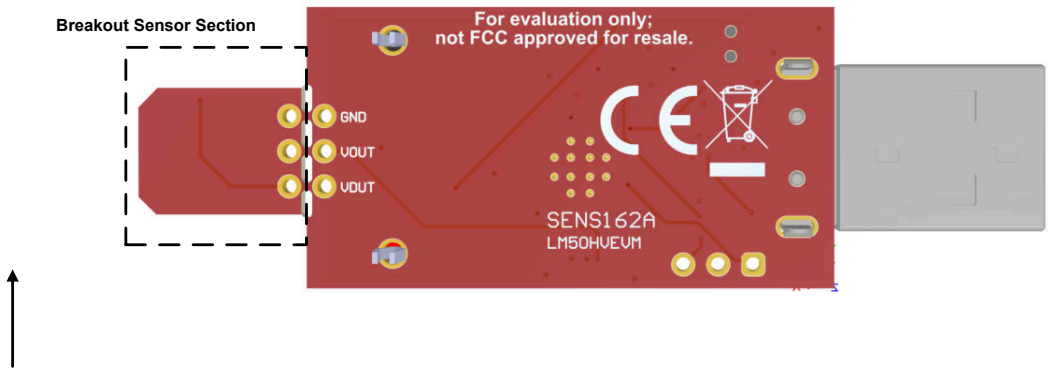


Figure 2-2. LM50HVEVM Board (Bottom View)

2.2 Perforations

There are perforations between the USB controller and the LM50HV sensor, these exist so that the two sides of the EVM can be broken apart easily. The two sides can be resoldered through the holes already on the EVM, allowing the LM50HV sensor to be placed in a high temperature chamber.

2.3 Status LEDs and Subregulator

The LM50HVEVM includes LEDs to indicate board status; the green LED D2 illuminates when VDUT is powered up correctly. D2 illuminates whether VDUT is supplied by the 3.3V from U7 or from an external voltage source. U7 is the onboard regulator which supplies the 3.3V net, and is enabled and disabled by switch SW2. For normal operation of the EVM with no external connections, SW2 must be set to the 3.3V net. By default, SW2 is set at a neutral middle position where the LM50HV is unpowered. To power the LM50HV, SW2 must be moved to either position to connect to the 3.3V net or an external power source.

The red LED D6 is the MSP430F5528 status LED. Table 2-1 shows what the different modes of operation mean.

Table 2-1. D6 LED Status

D6 LED STATUS	MEANING
Off	EVM is connected to EVM GUI
Blinking in 4 blink burst	EVM is plugged into PC, not connected to EVM GUI
Steady blinking	Connected to USB power

2.4 Programming Header

The LM50HVEVM comes pre-loaded with firmware necessary for correct operation. Header J2 is provided for Spy-Bi-Wire access to the MSP430F5528, but TI does not recommend that users access this header or reprogram the device.

2.5 Pushbutton Switch

Switch SW1 is used for entering USB BSL mode; this can be used for firmware updates. To enter BSL mode, connect the EVM to a PC USB port while holding down SW1.

2.6 RC Filter

On the sensor breakout board, R13 and C20 can be used for an optional RC circuit to filter the voltage output of the LM50HV. R13 is already installed on the board, but is a 0Ω jumper so acts as a short. C20 is not installed by default. The user can desolder R13, solder on a different resistor in the place of R13, and solder on a capacitor for C20 to create an RC filter.

The user must be aware to not use a capacitor value greater than 900nF for C20. The LM50HV has a maximum capacitive load of 1uF, however C19 on the controller portion of the EVM is a 100nF cap that is loaded onto the output voltage line. C19 prevents the voltage from dropping on the microcontroller ADC input, so C19 must not be removed. The ADC pin of the MSP430F5528 has 15pF of capacitive loading as well, although this is considered negligent when working on the scale of hundreds of nF.

To maintain output stability, phase margin (PM) must not be allowed to drop below 65°. When choosing a resistor and capacitor for an RC filter, refer to the data sheet to find resistor and capacitor values to keep the PM above 65° (see Section 6). C19, the 100nF capacitor placed near the ADC on the MCU side of the PCB, does count as part of the total capacitance for the PM calculation. For example if the user wants a filter with 200nF and 950Ω, the user must install a 100nF capacitor for C20.

3 Software

The LM50HVEVM software allows a user to read temperature from the LM50HV by using the MSP430F5528. The analog output voltage is read by the microcontroller and converted to displayed temperature in software. Once the EVM hardware is connected to the GUI, temperature is sampled automatically once the user navigates to the *Data Capture* tab. The LM50HVEVM GUI also contains a functional block diagram, key specs, and associated collateral for LM50HV.

3.1 Software Download

The PC GUI Software for LM50HVEVM runs on TI's GUI Composer framework. The software is available as a live version that runs in a browser and as a download for offline use. The software is compatible with Microsoft® Windows®, Mac®, and Linux® operating systems.

3.1.1 Online Software

Access the online version by going to LM50HVEVM gallery page. The online software works with Google Chrome®, Firefox®, and Safari® browsers. Users can access the live GUI be following the link and clicking on the application icon withing the gallery to launch the software. If prompted, install the TI Cloud Agent browser plug-in.

3.1.2 Offline Software

Fully offline version can be accessed by navigating to LM50HVEVM gallery page and downloading the application and runtime for Linux, Mac, or Microsoft Windows, and then following the on-screen installation instructions.

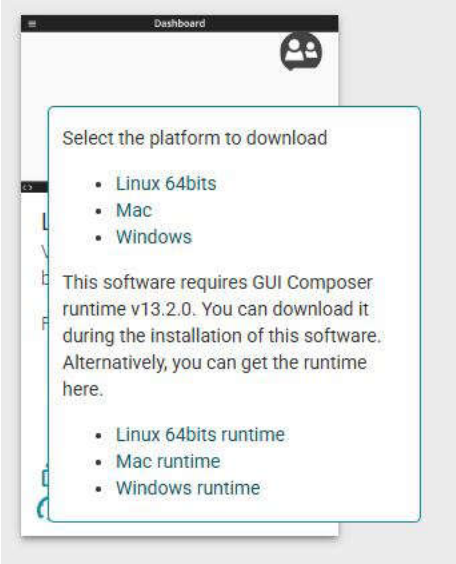


Figure 3-1. Download Pop-Up

3.2 Home Tab

When opening the GUI, the *Home* tab is displayed, see the figure below. From the home tab, device features such as a key specs and a functional block diagram can be seen when clicking the *Learn More* button. From the Home tab, there are shortcuts on the left bar and on the bottom to the *Data Capture* tab and the *Collateral* tab.

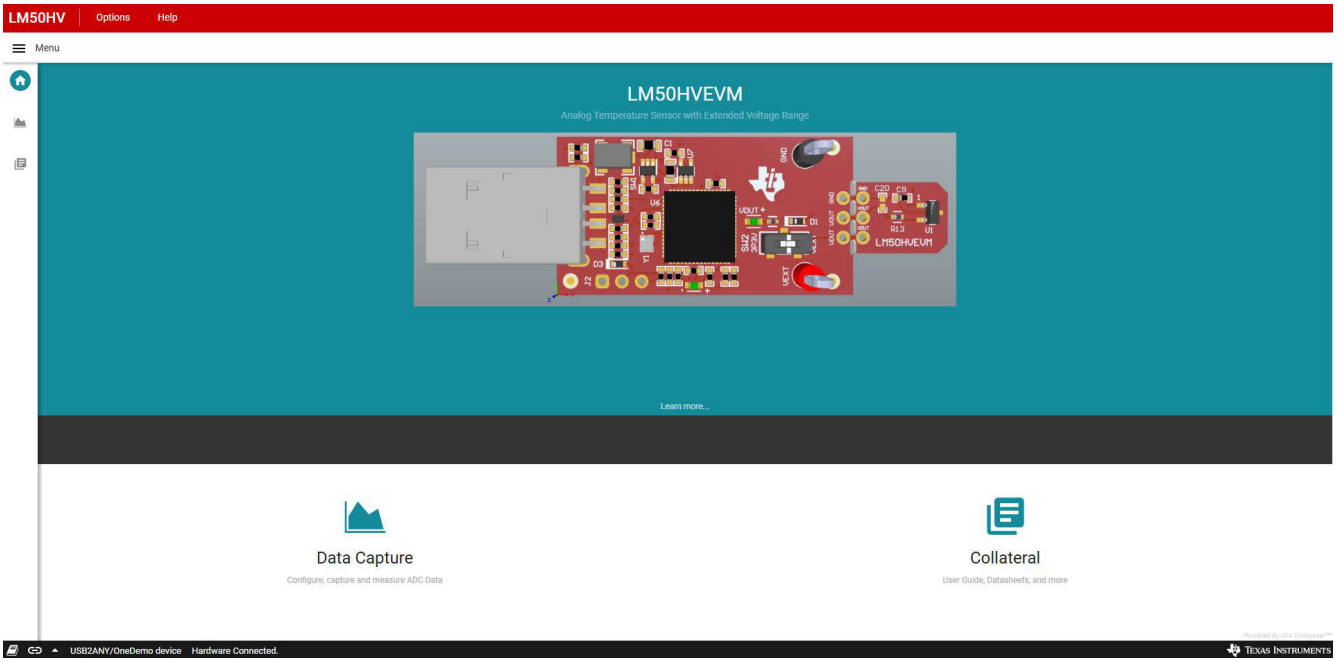


Figure 3-2. Home Tab

3.3 Data Capture Tab

The *Data Capture* tab automatically begins making temperature measurements. The data displays on a graph that scales with the temperature readings with recorded temperature on the y-axis, and measurement count on the x-axis. The default capture rate is 1 measurement per second. The drop-down menu allows the user to choose a different measurement rate, with the following options:

- Off
- As fast as possible
- Every 500ms
- Every 1s
- Every 5s
- Every 10s
- Every 60s

The *SAVE START* and *SAVE STOP* buttons enable the user to log the EVM temperature results in a .csv file. When *SAVE START* is selected, the file begins downloading, and downloading ends when *SAVE STOP* is selected.

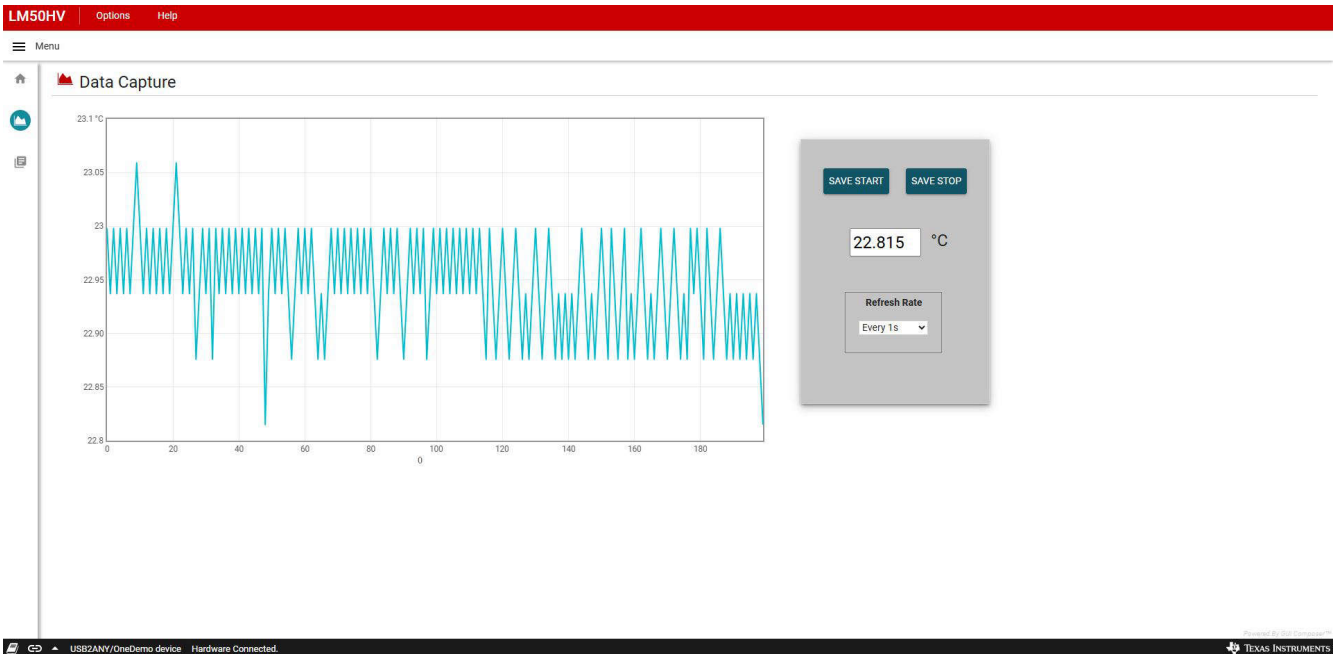


Figure 3-3. Data Capture Tab

3.4 Collateral Tab

The *Collateral* tab contains links to relevant sites and documentation for the EVM. This includes links to the EVM user's guide, the LM50HV data sheet (Section 6), the tool page on http://www.ti.com, any application notes, compliance documentation, and any other relevant literature.

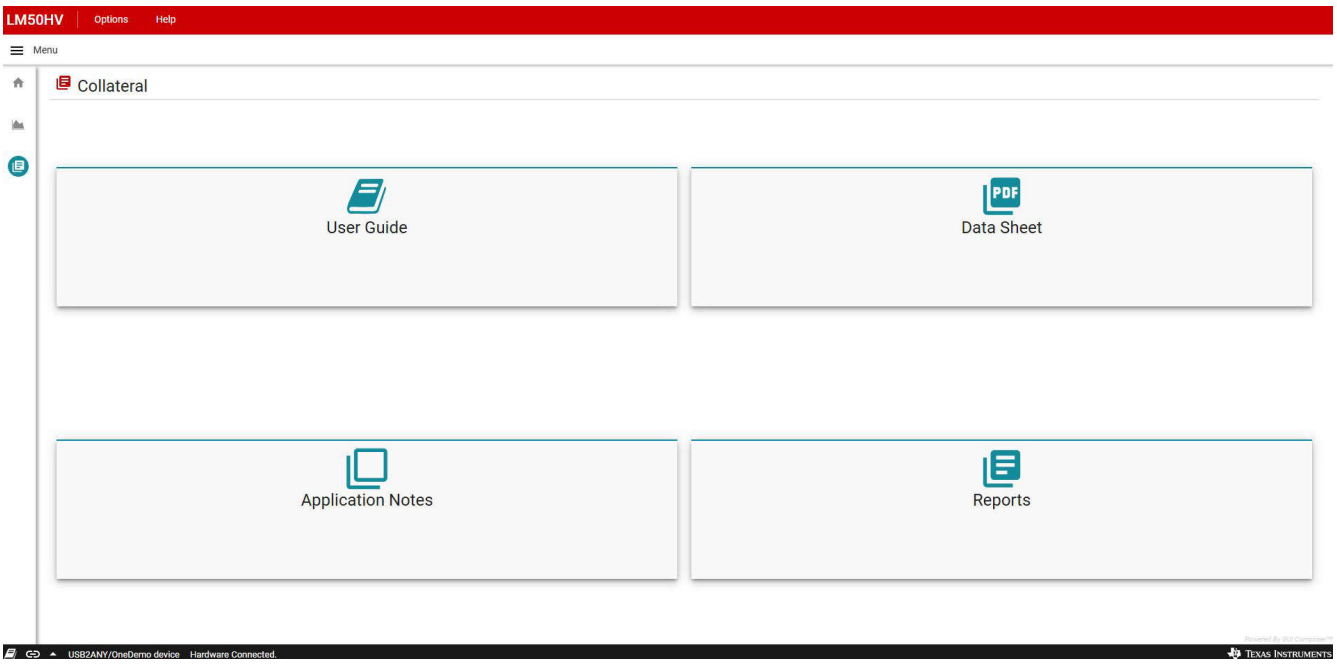


Figure 3-4. Collateral Tab

4 Hardware Design Files

4.1 LM50HVEVM Schematic

Figure 4-1 shows the EVM schematic.

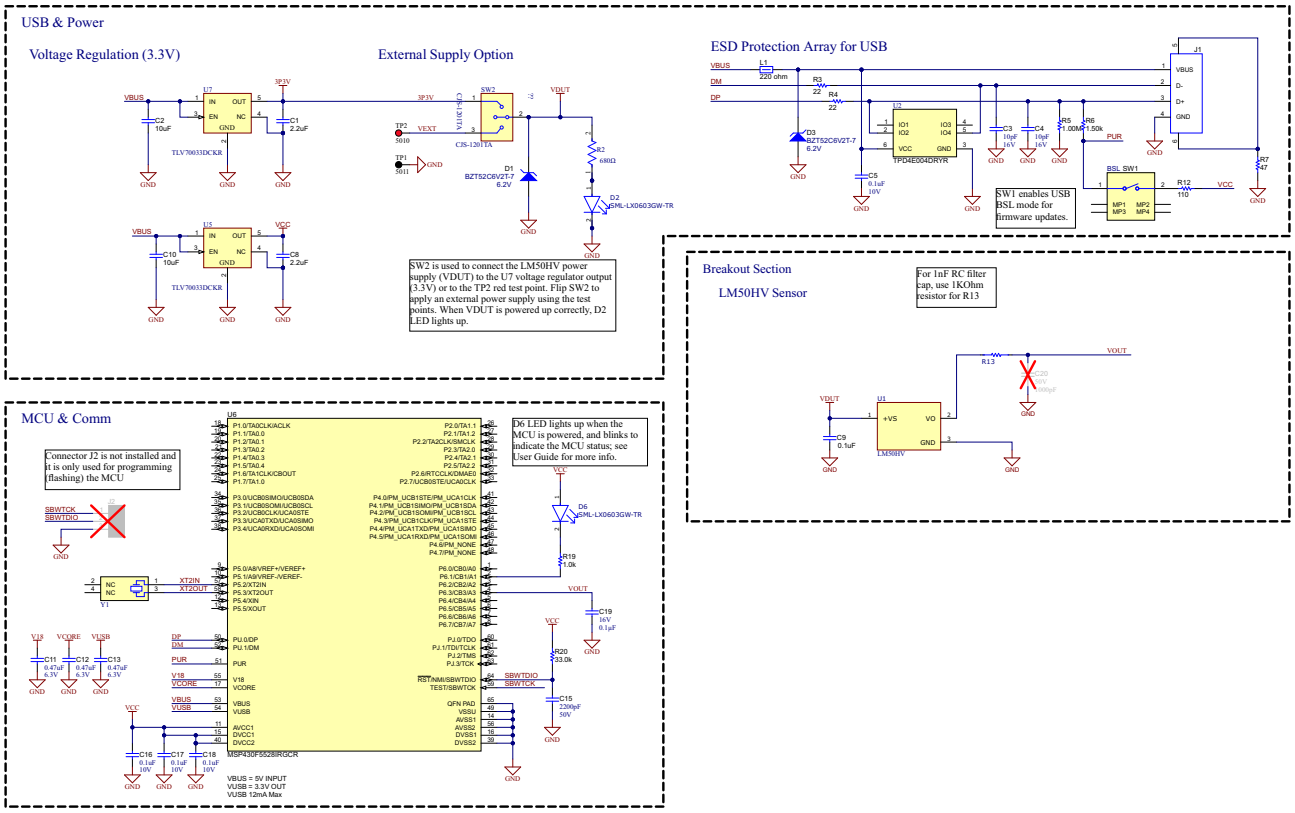


Figure 4-1. LM50HVEVM Schematic

4.2 PCB Layout

Figure 4-2 and Figure 4-3 show the EVM PCB layout images.

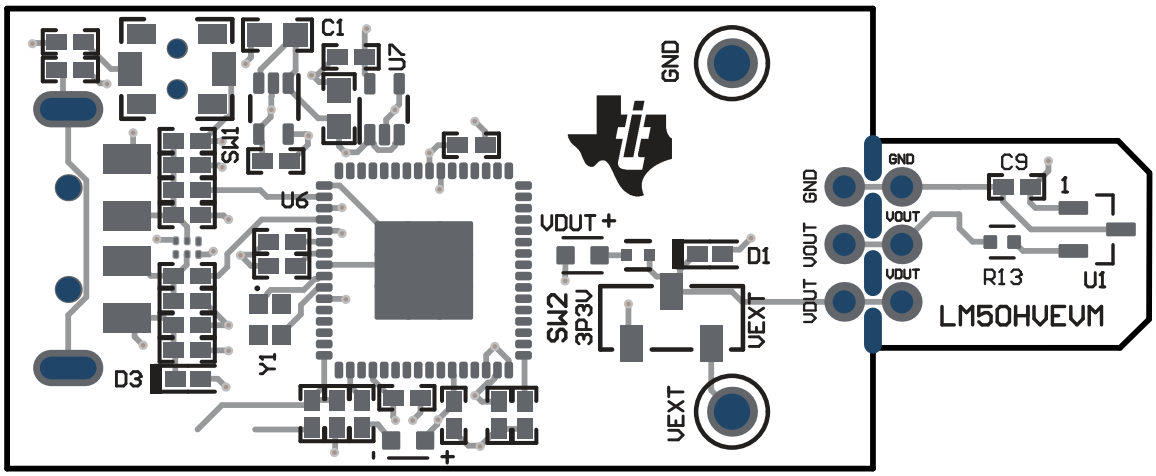


Figure 4-2. Top View

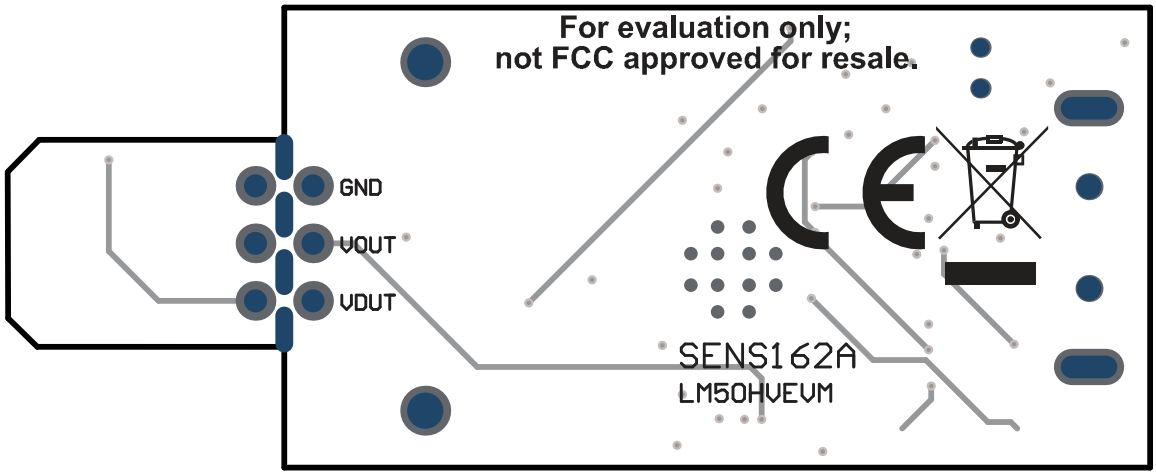


Figure 4-3. Bottom View

4.3 Bill of Materials (BOM)

The EVM bill of materials is shown below.

Table 4-1. LM50HVEVM BOM

Fitted	Designator	Qty	Value	Description	Part Number	Manufacturer	Package Reference
Fitted	!PCB1	1		Printed Circuit Board	SENS162	Any	
Fitted	C1, C8	2	2.2uF	CAP, CERM, 2.2uF, 16V, +/- 10%, X5R, 0402	GRM155R61C225KE11D	MuRata	0402
Fitted	C2, C10	2	10uF	CAP, CERM, 10uF, 10V, +/- 20%, X5R, 0603	C1608X5R1A106M080AC	TDK	0603
Fitted	C3, C4	2	10pF	CAP, CERM, 10pF, 16V,+/- 10%, C0G, 0402	C0402C100K4GACTU	Kemet	0402
Fitted	C5, C16, C17, C18	4	0.1uF	CAP, CERM, 0.1uF, 10V,+/- 10%, X5R, 0402	LMK105BJ104KV-F	Taiyo Yuden	0402
Fitted	C9	1	0.1uF	CAP, CERM, 0.1uF, 16V, +/- 10%, X7R, 0402	ATC530L104KT16T	AT Ceramics	0402
Fitted	C11, C12, C13	3	0.47uF	CAP, CERM, 0.47uF, 6.3V, +/- 10%, X7R, 0402	JMK105B7474KVHF	Taiyo Yuden	0402
Fitted	C15	1	2200pF	CAP, CERM, 2200pF, 50V, +/- 5%, X7R, 0402	CL05B222JB5NNNC	Samsung Electro-Mechanics	0402
Fitted	C19	1	0.1uF	CAP, CERM, 0.1µF, 16V,+/- 5%, X7R, AEC-Q200 Grade 1, 0402	GCM155R71C104JA55D	MuRata	0402
Fitted	D1, D3	2	6.2V	Diode, Zener, 6.2V, 300mW, SOD-523	BZT52C6V2T-7	Diodes Inc.	SOD-523
Fitted	D2, D6	2		Green LED Indication - Discrete 2.2V 0603 (1608 Metric)	SML-LX0603GW-TR	Lumex	0603
Fitted	J1	1		Connector, Plug, USB Type A, R/A, Top Mount SMT	48037-1000	Molex	USB Type A right angle
Fitted	L1	1	220ohm	Ferrite Bead, 220ohm @ 100MHz, 0.45A, 0402	BLM15AG221SN1D	MuRata	0402
Fitted	R2	1					
Fitted	R3, R4	2	22	RES, 22, 5%, 0.1W, AEC-Q200 Grade 0, 0402	ERJ-2GEJ220X	Panasonic	0402
Fitted	R5	1	1.00Meg	RES, 1.00M, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	RMCF0402FT1M00	Stackpole Electronics Inc	0402
Fitted	R6	1	1.50k	RES, 1.50k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	RMCF0402FT1K50	Stackpole Electronics Inc	0402

Table 4-1. LM50HVEVM BOM (continued)

Fitted	Designator	Qty	Value	Description	Part Number	Manufacturer	Package Reference
Fitted	R7	1	47	RES, 47, 5%, 0.1W, AEC-Q200 Grade 0, 0402	ERJ-2GEJ470X	Panasonic	0402
Fitted	R12	1	110	RES, 110, 1%, 0.1W, AEC-Q200 Grade 0, 0402	ERJ-2RKF1100X	Panasonic	0402
Fitted	R13	1	0	RES Thick Film, 0Ω, 0.2W, 0402	CRCW04020000Z0EDHP	Vishay Dale	0402
Fitted	R19	1	1.0k	RES, 1.0k, 5%, 0.1W, AEC-Q200 Grade 0, 0402	ERJ-2GEJ102X	Panasonic	0402
Fitted	R20	1	33.0k	RES, 33.0k, 1%, 0.063 W, 0402	RC0402FR-0733KL	Yageo America	0402
Fitted	SW1	1		Switch, SPST-NO, Off-Mom, 0.05A, 12VDC, SMD	PTS820J20M SMTR LFS	C&K Components	3.9x2.9mm
Fitted	SW2	1		SWITCH SLIDE SPDT 100MA 6V		Copal Electronics Inc	
Fitted	TP1	1		Test Point, Black, Through Hole, RoHS, Bulk		Keystone	5011
Fitted	TP2	1		Test Point, Red, Through Hole, RoHS, Bulk		Keystone	5010
Fitted	U1	1		Temperature Sensor in SOT-23 Package	LM50HV	Texas Instruments	SOT23-3
Fitted	U2	1		4-Channel ESD Protection Array for High-Speed Data Interfaces, DRY0006A (USON-6)	TPD4E004DRYR	Texas Instruments	DRY0006A
Fitted	U5, U7	2		Single Output LDO, 200mA, Fixed 3.3V Output, 2 to 5.5V Input, with Low IQ, 5-pin SC70 (DCK), -40 to 125 degC, Green (RoHS & no Sb/Br)	TLV70033DCKR	Texas Instruments	DCK0005A
Fitted	U6	1		16-Bit Ultra-Low-Power Microcontroller, 128KB Flash, 8KB RAM, USB, 12Bit ADC, 2 USCIs, 32Bit HW MPY, RGC0064B (VQFN-64)	MSP430F5528IRGCR	Texas Instruments	RGC0064B
Fitted	Y1	1		Crystal, 24MHz, SMD	XRCGB24M000F2P00R0	MuRata	2x1.6mm
Not Fitted	C20	0	1000pF	CAP, CERM, 1000pF, 50V, +/- 5%, C0G/NP0, 0402	C1005NP01H102J050BA	TDK	0402
Not Fitted	J2	0		Header, 100mil, 3x1, Gold, TH	TSW-103-07G-S	Samtec	3x1 Header

5 Additional Information

5.1 Trademarks

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Mac® and Safari® are registered trademarks of Apple Inc.
Linux® is a registered trademark of Linus Torvalds.
Chrome® is a registered trademark of Google LLC.
Firefox® is a registered trademark of Mozilla Foundation.
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6 Related Documentation

- Texas Instruments, LM50 Industry-Standard, Analog Centigrade (10mV/°C) Temperature Sensor in SOT-23 Package, data sheet
- Texas Instruments, LM50-Q1 Automotive (Grade 1), ±3°C Accurate, Analog Centigrade (10mV/°C) Temperature Sensor in SOT-23 Package, data sheet

STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.

   1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM (“Software”) shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software

   1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2 *Limited Warranty and Related Remedies/Disclaimers*:

   2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

WARNING

Evaluation Kits are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems.

User shall operate the Evaluation Kit within TI’s recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI’s recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI’s instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGREDATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 *Regulatory Notices:*

3.1 *United States*

3.1.1 *Notice applicable to EVMs not FCC-Approved:*

FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。

https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

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東京都新宿区西新宿 6 丁目 2 4 番 1 号

西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-for-power-line-communication.html

3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

6. *Disclaimers:*

6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.

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